Name:
Period:
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Poisson Distribution Homework

1. It is sometimes possible to obtain approximate probabilities associated with values of a random variable by using the probability distribution of a different random variable. For example, binomial probabilities using the Poisson probability function, binomial probabilities using the normal etc. In order for the Poisson to give "good" approximate values for binomial probabilities we must have the condition(s) that:
   (a) the population size is large relative to the sample size.
   (b) the sample size is large
   (c) the probability, p, is small and the sample size is large
   (d) the probability, p, is close to .5 and the sample size is large
   (e) the probability, p, is close to .5 and the population size is large

2. Suppose flaws (cracks, chips, specks, etc.) occur on the surface of glass with density of 3 per square metre. What is the probability of there being exactly 4 flaws on a sheet of glass of area 0.5 square metre?
   (a) 0.047
   (b) 0.168
   (c) 0.981
   (d) 0.815
   (e) 0.647

3. The rate at which a particular defect occurs in lengths of plastic film being produced by a stable manufacturing process is 4.2 defects per 75 metre length. A random sample of the film is selected and it was found that the length of the film in the sample was 25 metres. What is the probability that there will be at most 2 defects found in the sample?
   (a) .2102
   (b) .2417
   (c) .8335
   (d) .1323
   (e) .1665

Refer to the previous question. The manufacturer decides to examine a larger amount of film. She selects 1000 m of film. If there were no change in the defect rate from the old process, what would be the number of defects seen in approximately 95% of such examinations?
   (a) (49 to 63)
   (b) (34 to 78)
   (c) (62 to 98)
   (d) (41 to 71)
   (e) (71 to 89)

4. The number of traffic accidents per week in a small city has a Poisson distribution with mean equal to 1.3. What is the probability of at least two accidents in 2 weeks?
   (a) 0.2510
   (b) 0.3732
   (c) 0.5184
   (d) 0.7326
   (e) 0.4816

5. The number of traffic accidents per week in a small city has Poisson distribution with mean equal to 3. What is the probability of at least one accident in 2 weeks?
   (a) 0.0174
   (b) 0.9502
   (c) 0.9975
   (d) 0.1991
   (e) 0.0025

6. Significant birth defects occur at a rate of about 4 per 1000 births in human populations. After a nuclear accident, there were 10 defects observed in the next 1500 births. Find the probability of observing at least 10 defects in this sample if the rate had not changed after the accident.
   (a) .008
   (b) .003
   (c) .041
   (d) .084
   (e) .042

7. Refer to the previous question. An approximate 95% interval for the number of defects that would occur in 1500 births (assuming that the rate has not changed) is:
   (a) (4, 8)
   (b) (2, 10)
   (c) (2, 6)
   (d) (0, 8)
   (e) (0, 12)

8. In a certain communications system, there is an average of 1 transmission error per 10 seconds. Let the distribution of transmission errors be Poisson. What is the probability of more than 1 error in a communication one-half minute in duration?
   (a) 0.950
   (b) 0.262
   (c) 0.738
   (d) 0.199
   (e) 0.801

9. Bacteria in hamburger are distributed through out the meat. Suppose that a large batch of hamburger has an average contamination of 0.3 bacteria/gram. Then the probability that a 10 gram sample will contain one or fewer bacteria is:
   (a) .2222
   (b) .7408
   (c) .9603
   (d) .1494
   (e) .1992

10. Refer to the previous question. A 95% range for the likely number of bacteria present in a 100 g sample is:

    (a) 30ś30.0
    (b) 30ś5.5
    (c) 30ś11.0
    (d) 30ś16.4
    (e) 30ś2.8

11. The number of bacteria in a drop of water from a lake has a Poisson distribution with an average of 0.5 bacteria/drop. A small dish containing four drops of water from the lake is placed under a microscope. The probability of observing at most one bacteria in the sample is

    (a) 0.910
    (b) 0.406
    (c) 0.271
    (d) 0.135
    (e) 0.303

12. Refer to the previous question. An approximate 95% range for the number of bacteria present in 400 drops of water is:

    (a) (171,229)
    (b) (361,439)
    (c) (185,215)
    (d) (157,243)
    (e) (0,400)

13. Which of the following is NOT applicable to a Poisson Distribution?

    (a) It is used to compute the probability of rare events.
    (b) Every event is independent of every other event.
    (c) It is parameterized by the sample size and the probability that an event will occur.
    (d) The theoretical range for the number of events that could occur is 0,1,2,3, ...
    (e) In order to compute the parameter value, we need to know the standardized rate and the sample size.

14. In a biological cell the average member of genes that will change into mutant genes, when treated radioactively, is 2.4. Assuming Poisson probability distribution find the probability that there are at most 3 mutant genes in a biological cell after the radioactive treatment.

    (a) .2090
    (b) .7576
    (c) .5697
    (d) .7787
    (e) 1.000

15. The number of telephone calls that pass through a switchboard has a Poisson distribution with mean equal to 2 per minute. The probability that no telephone calls pass through the switch board in two consecutive minutes is:

    (a) 0.2707
    (b) 0.0517
    (c) 0.0183
    (d) 0.0366
    (e) 0.1353

16. The distribution of phone calls arriving in one minute periods at a switchboard is assumed to be Poisson with the parameter λ. During 100 periods, the following distribution was obtained:

# (calls)	0	1	2	3	4 or more
Frequency	30	43	21	6	0

    An estimate for λ based on this data set is:

    (a) 1.00
    (b) 1.03
    (c) 1.04
    (d) 1.33
    (e) 1.37

17. A can company reports that the number of breakdowns per 8-hour shift on its machine-operated assembly line follows a Poisson distribution with a mean of 1.5. Assuming that the machine operates independently across shifts, what is the probability of no breakdowns during three consecutive 8-hour shifts?

    (a) .0744
    (b) .0498
    (c) .6065
    (d) .2231
    (e) .0111

18. A fisherman arrives at his favorite fishing spot. From past experience he knows that the number of fish he catches per hour follows a Poisson distribution at 0.5 fish/hour. The probability that he catches at least 3 fish in four hours is:

    (a) .0126
    (b) .0144
    (c) .1804
    (d) .3233
    (e) .8571

19. The number of arrivals per hour at an automatic teller machine is Poisson distributed with a mean of 3.5 arrivals/hour. What is the probability that more than three arrivals occur in an hour?

    (a) .3209
    (b) .4633
    (c) .5367
    (d) .6791
    (e) .7246